PATENT

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FOR

SYSTEM AND PROCESS FOR CONTROLLING THE DECELERATION AND ACCELERATION RATES OF A SHEET MATERIAL IN FORMING ABSORBENT ARTICLES

OF

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SYSTEM AND PROCESS FOR CONTROLLING THE DECELERATION AND ACCELERATION RATES OF A SHEET MATERIAL IN FORMING ABSORBENT ARTICLES

Background of the Invention

The manufacture of products such as disposable absorbent articles involves the use of flexible materials. The flexible materials can include, by way of illustration, non-woven materials, elastic materials, adhesive tapes, polymeric films, release paper, mechanical fastening materials, paper webs, and the like. During the formation of products, these materials are typically unwound from relatively large rolls of material and fed into a process where the material is manipulated, possibly combined with other materials, and formed into products.

When feeding a roll of material into a process, typical unwind systems may include an unwind device that is configured to hold a roll of material and to unwind the material. Such systems can also include a splicing device, a festoon, and a dancer roll.

The splicing device is for splicing a first material to a second material when the roll containing the first material is exhausted and needs to be replaced by a second full roll of material.

The basic purpose of a dancer roll is to feed the material into a process under substantially constant tension. Dancer rolls are typically positioned between two sets of driving rolls. As the material passes over the dancer roll, the dancer roll moves up and down in a track, serving two functions related to stabilizing the tension in the material. First, the dancer roll provides a tensioning force to the material. Second, the dancer roll temporarily absorbs the difference in drive speeds between the first and second sets of driving rolls. Dancer rolls are described in detail in U.S. Patent No. 6,473,669 to Rajala et al., which is incorporated herein by reference.

Festoons, which may be placed in between the unwind device and the dancer roll, are designed to accumulate and temporarily hold a limited length of the material. The accumulated material is then released or additional length is accumulated when processing of the continuous material is temporarily

interrupted. Such temporary interruptions can be, for example, when splicing a first material to a second material.

Festoons can include, for instance, a row of top idler rolls spaced from a row of bottom idler rolls. The top idler rolls are connected to a carriage that allows the rolls to move towards and away from the bottom idler rolls. The material is threaded through the festoon by passing back and forth between the bottom idler rolls and the top idler rolls. In this manner, the festoon is capable of accumulating the needed amount of material. In order to release the material, the top idler rolls move towards the bottom idler rolls decreasing the amount of material held in the festoon. Likewise, in order to increase the capacity of the festoon, the top idler rolls may move away from the bottom idler rolls.

During, for instance, a splice operation, a first roll of material is decreased in speed from the process speed to a slower speed or even stopped. Once the speed of the web is lowered, a splicing device splices a second roll of material to the first roll of material. During this time, material accumulated in the festoon continues to feed material into the process without interruption. The second roll of material is then accelerated to a rate greater than the process speed in order to re-supply the festoon. Once the festoon has accumulated a sufficient amount of material, the unwind speed of the second roll of material is decreased to the process speed.

During the above splicing operation, the idler rolls contained in the festoon are accelerated and decelerated in conjunction with the rate at which the material is unwound. In the past, material tension on the idler rolls was used to decelerate and accelerate the rolls. Consequently, the rolls were made with a low mass and low inertia.

As the need for higher process speeds increases, however, the festoon capacity required to make splices or account for other interruptions becomes prohibitably high. Further, materials are being made with very low moduli of elasticity which may become damaged or break should the material be subjected to moderate increases in tension during interruptions. As such, a need currently exists for an improved system of unwinding a roll of material that reduces the amount of festoon capacity required and which minimizes tension swings in the festoon during interruptions.

Summary of the Invention

The present invention is generally directed to a system and process for unwinding a roll of material. The system and process of the present invention are particularly well suited for feeding materials into a processing line during the construction of absorbent articles. For example, in one embodiment, the system of the present invention includes a first supply station for providing a cover material into a processing line, a second supply station for providing a liner material into a processing line, and an absorbent supply source for providing an absorbent material into the processing line. The processing line is configured to place the absorbent material in between the cover material and the liner material for forming absorbent articles.

In accordance with the present invention, at least one of the cover material, the liner material, or the absorbent material is provided from an unwinding apparatus that comprises an unwind device for controlling the rate at which the roll of material is unwound. For example, in one embodiment, the unwind device rotates a spindle upon which the roll of material is mounted. Alternatively, the drive mechanism may apply a tangential force to an exterior surface of the roll of material for unwinding the roll.

A tension control device is included in the system for controlling the tension of the material after the material is unwound. For instance, the tension control device may be used so that the material is fed into a process under substantially constant tension. In one embodiment, the tension control device comprises a dancer roll spaced from a pair of stationary rolls. The dancer roll applies a determined amount of force against the material and is movable towards and away from the stationary rolls. The stationary rolls may be idler rolls or may be driven rolls.

The system further includes a festoon positioned between the unwind device and the tension control device. The festoon comprises a first set of guide rolls spaced from a second set of guide rolls. The first set of guide rolls is in operative association with a carriage. The carriage is movable towards the second set of guide rolls when a determined amount of force is placed on the carriage by the material threaded through the festoon. The festoon accumulates a determined

length of the material sufficient to sustain temporary stoppages by the unwind device during an unwind process.

In accordance with the present invention, the system further includes a plurality of drive devices coupled to selected guide rolls contained in the festoon. Each of the drive devices are configured to decelerate and/or accelerate a corresponding guide roll, when the drive mechanism respectively decreases or increases the rate at which the roll of material is unwound.

By controlling the deceleration and/or acceleration rate of the guide rolls in the festoon, the storage capacity of the festoon may be reduced due to the shorter time requirements needed to decelerate and/or accelerate a material being unwound during normal stoppages, such as during a splice or during process startups or shutdowns. In this regard, process speeds may be increased without having to increase the storage capacity and size of the festoon. Tension swings in the festoon are also better controlled. Further, the unwind device may more quickly decelerate and more quickly accelerate a roll of material being unwound during interruptions without generating tensions in the festoon that may have adverse impacts upon the material or the process. The system and process of the present invention, in addition to improving web tension control, may also serve to minimize registration shifting during the process of making a product. Ultimately, the system and process of the present invention allow for faster downstream process speeds without a significant increase in the size of the festoon.

In one embodiment of the present invention, the drive devices contained in the festoon are used only to decelerate the guide rolls. In this embodiment, for instance, the drive devices may comprise brake devices. When the drive device is configured to decelerate or accelerate the guide rolls, on the other hand, the drive device may be a motor, such as a servo motor or a stepper motor.

Each drive device may be controlled by a controller, such as a microprocessor. Each drive device may be in association with a speed sensor that monitors the speed of each guide roll. Each speed sensor may send information to the controller which, in turn, accelerates and/or decelerates the guide rolls according to a predetermined deceleration or acceleration curve or profile. In one embodiment, the control of all the drive devices is coordinated to work as a system but the acceleration and/or deceleration rate of each guide roll is controlled

independently according to a profile that is dependent upon the position of the guide roll on the festoon.

The festoon may include from about four (4) to about ten (10) guide rolls. For example, the festoon can include an upstream guide roll, a plurality of midstream guide rolls, and a downstream guide roll. Drive devices can be placed in association with the upstream guide roll and all of the midstream guide rolls. In general, a drive device will usually not be needed on the downstream guide roll.

In addition to a system for producing absorbent articles, the present invention is also directed to a process for producing absorbent articles. The absorbent articles are produced from a material that is unwound at a determined rate using an unwind device. The unwind device may be in communication with a festoon. The festoon includes a plurality of rotatable guide rolls through which the material being unwound is threaded. The festoon accumulates a determined length of the material sufficient to sustain temporary stoppages by the unwind device during the unwind process.

At periodic intervals, the rate at which the roll of material is unwound is decreased at the unwind device causing the accumulated length of material contained in the festoon to be released in order for the rate at which the material is moving downstream of the festoon to remain substantially unchanged. During these periodic intervals, according to the present invention, certain of the guide rolls in the festoon may be actively decelerated. The guide rolls are decelerated independent of each other. Further, the guide rolls are decelerated at a rate that generally corresponds to the rate at which the material is decelerated through the festoon. In this manner, the determined length of material that is accumulated in the festoon is minimized and tension swings in the festoon during rate decreases are lessened.

The process and system of the present invention may be integrated into various process lines for forming absorbent articles, such as diapers, adult incontinence products, feminine hygiene products, and the like. During the formation of absorbent articles, many different materials may be unwound and fed into the process for forming various elements on the formed article. The unwind system of the present invention can be used to unwind any or all of the materials being fed to the process.

For instance, in one embodiment, a processing line for forming absorbent articles contains from about 1 to about 10 or greater unwind devices in conjunction with festoons made in accordance with the present invention. The unwind device and festoon configured in accordance with the present invention may be used to unwind, for instance, cover materials, liner materials, elastic components, films, and the like.

These and other features of the present invention are discussed in greater detail below.

Brief Description of the Drawings

A full and enabling disclosure of the present invention, including the best mode thereof to one skilled in the art, is set forth more particularly in the remainder of the specification, including reference to the accompanying figures, in which:

Figure 1 is a perspective view of one embodiment of an unwind system made in accordance with the present invention;

Figures 2A, 2B and 2C are side views of another embodiment of an unwind system made in accordance with the present invention;

Figure 3 is a perspective view of one embodiment of an absorbent article that may be made using the system of the present invention;

Figure 4 is a perspective view of another embodiment of an absorbent article that may be made using the system of the present invention;

Figure 5 is a plan view of an absorbent article that may be made using the system of the present invention;

Figure 6 is a plan view of another embodiment of an absorbent article that may be made using the system of the present invention; and

Figure 7 is a perspective view of one embodiment of a process for forming an absorbent article incorporating an unwind device and festoon made in accordance with the present invention.

Repeat use of reference characters in the present specification and drawings is intended to represent the same or analogous features or elements of the invention.

Detailed Description

It is to be understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only, and is not intended as

limiting the broader aspects of the present invention, which broader aspects are embodied in the exemplary construction.

In general, the present invention is directed to an unwind system designed to feed a material into a process. Any suitable material may be unwound in accordance with the present invention. For example, representative of materials that may be processed according to the present invention include nonwoven materials, elastic materials, adhesive tapes, polymeric films, mechanical fastening materials, paper webs, tissue products, and the like. These materials may be fed into a process during the formation of various different types of products. For example, the materials may be fed into a process and manipulated in order to form personal care articles, diapers, incontinence pads, feminine hygiene products, tissue products, and the like.

The system of the present invention generally includes an unwind device that is configured to unwind a roll of material. From the unwind device, the material is fed into a festoon and optionally around a dancer roll prior to undergoing downstream processing.

The festoon contained in the system is designed to hold, at steady-state operation, an accumulation of the material being fed into the process. The festoon is also designed to release the material or accumulate greater amounts of the material should there exist a speed difference between the rate at which the material is being unwound and the rate at which the material is being processed downstream.

For example, in many processes, it is desirable to feed the material into a downstream process at constant speed. The festoon may be used to ensure that the speed of the web remains unchanged even if the unwind device temporarily stops unwinding the material or, alternatively, temporarily accelerates the rate at which the material is unwound. For example, unwind devices are normally interrupted when a first roll of material is exhausted and it becomes necessary to splice a second full roll of material to a nearly unwound first roll of material.

Festoons typically contain a first row of guide rolls spaced from a second row of guide rolls. The material being unwound is threaded back and forth through the guide rolls which allows for an accumulation of the material. In one embodiment, the top guide rolls may be associated with a carriage that moves

towards and away from the bottom guide rolls. When the carriage moves towards the bottom guide rolls, the amount of material stored in the festoon is reduced. When the carriage is moved away from the bottom guide rolls, on the other hand, the amount of material stored in the festoon is increased. During steady-state processing, each of the guide rolls rotate at approximately the same speed and the carriage remains in a set position. During interruptions in the rate at which the material is unwound, however, material in the festoon is either released or the amount of material stored in the festoon is increased. During these occurrences, the speed of the guide rolls vary from roll to roll. For example, should a temporary stoppage occur of the unwind device, the speed of the guide rolls may vary from zero at the upstream end to full speed at the downstream end.

In the past, the buildup of material tension through the festoon was used in order to decelerate the guide rolls and a reduction of material tension was used in order to accelerate the guide rolls. Thus, during unwind interruptions, tension swings occurred in the festoon. The minimum and maximum tension in the material is a function of the unwind deceleration and acceleration rates, guide roll inertia, festoon capacity, machine speed, festoon pressure, bearing drag, and other factors.

In general, the present invention is directed to a method and system for controlling the deceleration and acceleration rates of the guide rolls in the festoon using a plurality of drive devices associated with selected guide rolls. By actively accelerating or decelerating the guide rolls instead of relying on material or web tension, the system of the present invention offers various advantages and benefits. For example, by controlling the acceleration and/or deceleration rates of the guide rolls, the acceleration and deceleration rates of the spindles can be increased, and the festoon capacity can be minimized. Tension swings of the material in the festoon may also be reduced since web tension changes are not required to accelerate and decelerate idlers. Ultimately, the system of the present invention allows for faster processing speeds without having to increase festoon storage capacity which increases the throughput of product being produced.

Further, the system and process of the present invention are also well suited to controlling web tension during process shutdowns and process startups.

Referring to Figure 1, one embodiment of an unwind system made in accordance with the present invention is illustrated. As shown, the system includes an unwind device generally **10** for unwinding a roll of material. In this embodiment, the unwind device **10** includes a first position for holding a first roll of material **12** and a second position for holding a second roll of material **14**. The second roll of material **14** is a staging roll that is spliced to the first roll of material **12** when the first roll of material becomes exhausted. In this manner, the unwind device **10** can continuously feed material into the process.

The unwind device **10** can include any suitable drive mechanism for unwinding a roll of material either at the first position or at the second position. For example, in one embodiment, the drive mechanism can be a center unwind device that rotates a spindle **16** or **18** in order to unwind the material. Alternatively, the drive mechanism may comprise a surface unwind device that engages an exterior surface of the rolled material for unwinding the material. For example, in one embodiment, the surface unwind device may comprise a moving belt that is brought into contact with the roll of material.

In still another embodiment, a center unwind device may be used in conjunction with a surface unwind device.

As shown in Figure 1, a material **20** is unwound from the roll **12** and fed around an idler roll **22**. From idler roll **22**, the material **20** passes through a splicing device **24**. Splicing device **24** is for splicing the material **20** to a second roll of material **14** when the first roll of material **12** is exhausted. Thus, the splicing device **24** is activated at periodic intervals.

From the splicing device **24**, the material is fed through a festoon generally **26**, around a pair of driven feed rolls **38** and **39**, a dancer roll **28**, and an idler roll **40**. As shown, the material is in an S-wrap configuration when passing over the driven feed rolls **38** and **39**. In an alternative embodiment, however, it should be understood that a single driven feed roll may be used. When a single driven feed roll is used, the material **20** can be wrapped at least about 180 degrees around the roll. The speed of advance of the material **20** is controlled by the unwind device **10** in combination with the speed of the driven rolls **38** and **39**. Once exiting the idler roll **40**, the material **20** is manipulated and processed as desired in order to form a desired product or article.

The primary purpose of the dancer roll **28** is to attenuate tension disturbances in the web **20**. Such tension disturbances might come, for example, unintended, but none the less normal vibrations emanating from equipment downstream, raw material variability, wound roll variances, and variability in bearing drag. The dancer roll **28** applies a force against the material **20** which minimizes these disturbances for feeding the material **20** into the process under substantially constant tension.

As shown in Figure 1, the dancer roll **28** is placed in association with a pair of cylinders **34** and **36**. In another embodiment, dancer roll **28** can be in association with a single cylinder **34**. The cylinders **34** and **36** apply a force to the dancer roll **28** which is then applied to the web **20**. The cylinders **34** and **36** may be hydraulic cylinders or pneumatic cylinders.

The dancer roll **28** is movable towards and away from the driven feed rolls **38** and **39** and the idler roll **40** which are in a fixed position. In general, to the extent the process take-away speed exceeds the speed at which the material is supplied to the dancer roll, the static forces on the dancer roll cause the dancer roll to move downwardly within its operating window. In one embodiment, as the dancer roll moves downwardly, the change in position may be sensed by, for example, a position transducer, which sends a corrective signal to the driven feed rolls **38** and **39** to increase in speed. The speed of the driven feed rolls increases enough to return the dancer roll to the midpoint of its operating window.

By corollary, if the take-away speed lags the speed at which the material is supplied to the dancer roll, the static forces on the dancer roll cause the dancer roll to move upwardly within its operating window. As the dancer roll moves upwardly, the change in position may be sensed causing the driven rolls **38** and **39** to decrease in speed, thereby returning the dancer roll to a steady-state position.

By maintaining the dancer roll **28** at the same position with respect to the idler roll **40**, tension within the web of material **20** is maintained substantially constant, even if the downstream speed of the web changes. As will be described below, however, it should be understood that in an alternative embodiment, the dancer roll may be eliminated. In this embodiment, the festoon itself may be used in order to maintain the web at a relatively constant tension.

As described above, the purpose of the festoon **26** is to accumulate a determined length of the material **20**. Based upon the speed differences between the material **20** at the unwind device **10**, at the driven feed rolls **38** and **39**, and at a downstream position, the festoon **26** is designed to either release the material contained in the festoon or to accept larger amounts of the material in the festoon. For example, should the unwind speed be less than the downstream process speed of the material, the festoon **26** releases the material. Alternatively, if the unwind speed is greater than the downstream process speed, the festoon is configured to increase in capacity. In this manner, speed changes can occur at the unwind device **10** without affecting the downstream speed of the material being fed into the process.

As shown in Figure 1, the festoon **26** includes a row of bottom guide rolls **42A**, **42B**, **42C**, **42D**, **42E**, and **42F**, and a set of top guide rolls **44A**, **44B**, **44C**, **44D**, and **44E**. In this embodiment, the top guide rolls **44** are all connected to a carriage **46**. The carriage **46** is movable towards and away from the bottom guide rolls **42**. The bottom guide rolls **42** are in a fixed position. Not shown, the carriage **46** may be placed in operative association with one or more fluid cylinders as shown with respect to the dancer roll **28**. Each cylinder provides an upward force on the carriage which is offset by the web tension.

As illustrated, the material **20** is threaded back and forth between the bottom guide rolls **42** and the top guide rolls **44**. In this manner, the festoon **26** accumulates a determined length of material. When the carriage **46** moves towards the bottom guide rolls **42**, material contained within the festoon **26** is released to the process. Alternatively, when the carriage **46** is moved away from the bottom guide rolls **42**, the capacity of the festoon **26** increases and a greater length of material is accumulated in the festoon.

During steady-state operation, the festoon **26** may operate similar to the dancer roll **28**. In particular, if the festoon carriage **46** moves down due to web tension, the unwind device may be configured to automatically increase the speed at which the material is unwound. Similarly, if the carriage **46** moves up due to web tension, the unwind device may be configured to automatically decrease the speed at which the material is unwound in order to maintain the carriage in a

predetermined position. In this manner, in some embodiments, the dancer roll **28** may be eliminated from the system.

In the embodiment shown, the festoon **26** includes eleven (11) guide rolls. It should be understood, however, that more or less guide rolls may be contained in the festoon. For example, in many embodiments, the festoon can contain from about two (2) to about twenty (20) rolls, and particularly from about four (4) rolls to about ten (10) rolls.

In accordance with the present invention, at least certain of the guide rolls contained in the festoon **26** are placed in association with a drive device. For example, as shown in Figure 1, guide rolls **44A** through **44E** are in communication with corresponding drive devices **48A** through **48E**. Likewise, guide rolls **42A** through **42E** are in communication with corresponding drive devices **50A** through **50E**. The drive devices **48** and **50**, in accordance with the present invention, are for individually controlling the deceleration and/or the acceleration rates of each of the guide rolls. In this embodiment, only guide roll **42F** is not associated with a drive device. In most applications, guide roll **42F**, the downstream guide roll, rotates at a substantially constant speed making the use of a drive device unnecessary as will be described in more detail below. In some embodiments, guide roll **42F** is not even included, but instead a driven feed roll is located in its place.

The drive devices **48** and **50** accelerate and/or decelerate each corresponding guide roll in response to rate fluctuations occurring during splice sequences, during other temporary interruptions of the unwind process or during process shutdowns or startups. In this manner, tension swings through the festoon **26** are minimized. The festoon capacity required at a given line speed is also minimized. Further, by including the drive devices **48** and **50**, the unwind device **10** can decelerate and/or accelerate at faster rates without creating material tensions in the festoon that normally would adversely impact upon the material.

As shown in Figure 1, each drive device **48** and **50** is in communication with a controller **52**. Controller **52** is configured to control each drive device for accelerating and/or decelerating the guide rolls as desired. The controller can be, for instance, any suitable programmable device such as a microprocessor.

Further, the controller **52** can be a single programmable device or a plurality of programmable devices each connected to certain of the drive devices.

Optionally, the system further includes a plurality of speed sensors **54**. In particular, a speed sensor is positioned at each guide roll where a drive device is located. The speed sensor is for sensing the rotational speed of a corresponding guide roll. Further, each speed sensor **54** is in communication with the controller **52**. In this manner, the controller can receive information regarding the speed of each guide roll from the speed sensors **54** and, based upon the received information, can control each drive device **50** for decelerating and/or accelerating the guide rolls according to a predetermined profile or curve.

In general, any suitable speed sensor may be used according to the present invention. The speed sensor can be, for instance, a laser speed sensor, a contact tachometer, a non-contact tachometer, an encoder, and the like.

The drive devices **48** and **50**, on the other hand, may be any suitable device that is capable of either accelerating or decelerating a guide roll. For example, when the drive devices are configured only to decelerate the guide rolls, the drive devices can comprise brake devices. Suitable brake devices include any friction brakes or mechanical brakes. Other brake devices may include piezoelectric devices.

When it is desirable to not only decelerate the guide rolls but also to accelerate the guide rolls, the drive device may comprise a motor. Suitable motors that may be used include DC stepper motors or servo motors. Such motors in combination with a drive control system are commercially available from, for instance, Animatics Corporation and the Parker Hannifan Corporation.

According to the present invention, during the release or accumulation of material in the festoon **26**, the guide rolls in the festoon undergo a change in rotational speed. Further, in most applications, each guide roll is either accelerated or decelerated depending upon the circumstances independent of the other guide rolls. In the past, the acceleration or deceleration of the guide rolls was controlled by the tension of the material around the rolls. According to the present invention, however, the drive devices **48** and **50** are used to accelerate and decelerate the guide rolls independent of the other guide rolls. In this manner, the festoon may react much more quickly to changes or fluctuations in the

difference between the speed of the material entering the festoon and the speed of the material exiting the festoon.

In one embodiment, the controller **52** can be preprogrammed to accelerate and/or decelerate each guide roll according to a particular profile. The profile may be created after sufficient testing of the festoon or based on models to rate changes occurring either upstream or downstream of the festoon. These profiles can then be implemented through the use of information received from the speed sensors **54**.

Alternatively, the system may also operate without the use of the speed sensors. For example, in an alternative embodiment, drive devices may be used that have a particular torque profile or open loop speed control that is followed during the acceleration and/or deceleration of the guide rolls.

In Figure 1, the drive devices **48** and **50** are shown in association with ten (10) of the eleven (11) guide rolls contained in the festoon **26**. It should be understood, however, that in other embodiments a lesser number of drive devices may be desired. For example, when speed fluctuations of the material occur at the unwind device **10**, most of the rate change within the festoon occurs at the upstream guide rolls. Thus, in one embodiment, only drive devices may be needed or desired at the upstream end of the festoon. In other embodiments, drive devices may only be installed at the fixed end of the carriage, such as in association with the guide rolls **42** as shown in Figure 1. In still other embodiments, the drive devices may be placed in any particular pattern in conjunction with any guide roll as may be desired.

In order to better explain the present invention, a splice sequence will now be described with respect to Figures 2A, 2B and 2C. Like reference numerals have been included in the figures in order to represent similar elements or features.

During a splice sequence, a first roll of material is spliced to a second roll of material so that the second roll of material can be fed through the process. During a splice sequence, it is desirable that the downstream speed of the material remain unchanged. Referring to Figure 2A, the system of the present invention is shown in steady-state operation. During steady-state operation, in many applications, the drive devices are inactive. As illustrated, a first roll of material **12** is being

unwound and fed into the festoon **26** prior to entering a downstream process. A staging roll **14** is also shown that is intended to replace the first roll of material **12** when the first roll of material is exhausted. The festoon has accumulated material to be fed into the process during the splice sequence.

When it is time to splice the second roll **14** to the first roll **12**, the unwind speed of the material **20** is decelerated or stopped. A splicing device **24** then splices a second material **120** to the first material **20**.

During the interruption in the winding process, the carriage **46** of the festoon **26** moves towards the bottom set of guide rolls **42** releasing material that was stored in the festoon as shown in Figure 2B.

During the deceleration of the material **20**, certain guide rolls in the festoon **26** also decelerate. For instance, if the speed of material **20** was to stop, the guide rolls within the festoon would vary in speed from zero at guide roll **42A** to the downstream speed of the material at the guide roll **42F**. In the past, as the material **20** decelerated at splicing device **24**, tension built-up in material **20** in order to overcome the inertia of the guide rolls and slow them down. The maximum deceleration rate was a function of how much tension material **20** could tolerate. In the present invention, motors or brakes can be used to decelerate or help decelerate the guide rolls so that the tension increase in material **20** is minimized.

During the sequence, according to the present invention, the drive devices **48** and **50** may be activated by the controller causing the corresponding guide rolls to decelerate. Each guide roll may be controlled independently of the other guide rolls. In one embodiment, for instance, each guide roll may be decelerated according to a deceleration profile or curve.

Referring to Figure 2C, after a splice has occurred, the unwind device unwinds the second roll of material **14** into the process. At this point in the splice sequence, the carriage **46** continues to collapse until the spindle and guide rolls are accelerated back to line speed. The spindle speed or unwind speed of the material is then adjusted in order to bring the festoon carriage back to the run position. For instance, the material **120** may be fed into the festoon at a speed that is greater than the downstream speed of the material. When this occurs, the

carriage **46** of the festoon **26** moves away from the bottom guide rolls **42** causing an accumulation of material to occur within the festoon.

During this sequence of events, the guide rolls **44** and **50** may be accelerated. Alternatively, the guide roll **42F** may remain at the downstream process speed. In one aspect, each upstream guide roll may be accelerated to a slightly greater extent than each downstream guide roll.

During acceleration of the material **120**, according to the present invention, the drive devices **48** and **50** may be activated by a controller causing the corresponding guide rolls to accelerate. As before, each guide roll is accelerated at a rate that may be independent of the remaining guide rolls. For most applications, the guide rolls may be accelerated so as to minimize the tension drop required to accelerate the guide rolls.

By controlling the acceleration and/or the deceleration rates of the guide rolls, the system of the present invention allows for the unwind device to accelerate or decelerate a roll of material at a faster rate without adverse consequences so that faster process speeds can be reached or to process lower modulus materials at current speeds.

In addition to splice sequences, the system and process of the present invention may be used during other processing conditions, such as during process startup and shutdown events. For instance, in the past, during process shutdowns, the freely rotating idler rolls in a festoon coasted to a stop. The coasting was a result of the material feed rate slowing at driven points in the process and the friction of the idler rolls. With low tension materials, however, the coasting due to the inertia of the idler rolls can cause material tensions to be at a higher or lower value than desired and can cause registration shifts. The process and system of the present invention, however, may be used to control the deceleration of the guide rolls in the festoon to avoid the inertia and coasting effects on the material in the festoon.

During process startups, on the other hand, in conventional systems, the freely rotating idler rolls in a festoon must ramp up to speed. This ramping up is induced by the tension of the web as it is accelerated by the driven points in the process. The tension of the material in the festoon must overcome the inertia of the rotating idler rolls in the festoon which can cause the tension of the material to

be at a higher value than desired and can cause registration shifts. The process and system of the present invention, however, may be used to control the acceleration of the guide rolls in the festoon and reduce tension buildup in the material. Through the present invention, much weaker materials may be processed at production speeds without fear of breakage or other damage.

As stated above, the system of the present invention may be used to unwind various materials including nonwovens, wovens, elastic materials, polymeric films, adhesive tapes, mechanical fastening materials, paper webs, and the like. In one embodiment, the system of the present invention may be used to unwind materials during the formation of an absorbent article, such as diapers, training pants, incontinence articles and pads, feminine hygiene products, and the like. For example, referring to Figure 3, a pant-like absorbent article generally **60** is illustrated. The article **60** includes a chassis **62** defining a front region **64**, a back region **66**, and a crotch region **68** interconnecting the front and back regions. The chassis **62** includes a bodyside liner **70** which is configured to contact the wearer, and an outer cover **72** opposite the bodyside liner which is configured to contact the wearer's clothing. An absorbent assembly **74** (see Figure 6) is positioned or located between the outer cover **72** and the bodyside liner **70**.

Figure 4 illustrates an alternative embodiment of an absorbent article **60** similar to the absorbent article illustrated in Figure 1. Like reference numerals have been used to indicate similar elements. As shown, the absorbent article **60** shown in Figure 4, different than the embodiment shown in Figure 3, includes refastenable sides. The absorbent article **60** shown in Figure 3, on the other hand, has permanently bonded sides. Both embodiments of an absorbent article define a 3-dimensional pant configuration having a waist opening **76** and a pair of leg openings **78**. The front region **64** includes the portion of the article **60** which, when worn, is positioned on the front of the wearer while the back region **66** includes the portion of the article which, when worn, is positioned on the back of the wearer. The crotch region **68** of the absorbent article **60** includes the portion of the article which, when worn, is positioned between the legs of the wearer and covers the lower torso of the wearer.

As shown in further detail in Figures 5 and 6, the chassis **62** also defines a pair of longitudinally opposed waist edges which are designated front waist edge

80 and back waist edge **82**. The front region **64** is contiguous with the front waist edge **80**, and the back region **66** is contiguous with the back waist edge **82**. The waist edges **80, 82** are configured to encircle the waist of the wearer when worn and define the waist opening **76**. For reference, arrows **84** and **86** depicting the orientation of the longitudinal axis and the transverse axis, respectively, of the absorbent article **60** are illustrated in Figures 5 and 6.

The illustrated absorbent chassis **62** includes a pair of transversely opposed front side panels **88**, and a pair of transversely opposed back side panels **90**. The side panels **88, 90** may be integrally formed with the outer cover **72** and/or the bodyside liner **70** and/or containment flaps of the absorbent, if present, or may include two or more separate elements.

The side panels **88** and **90** desirably include an elastic material capable of stretching in a direction generally parallel to the transverse axis **86** of the absorbent article **60**. Suitable elastic materials, as well as processes of incorporating side panels into a training pant, are known to those skilled in the art, and are described, for example, in U.S. Patent No. 4,940,464 issued July 10, 1990 to Van Gompel et al., which is incorporated herein by reference.

As mentioned, the absorbent article **60** according to the present invention may be refastenable, thereby including a fastening system **92** for securing the training pant above the waist of the wearer (see Figure 4). The illustrated fastening system **92** may include fastening components **94** that are adapted to refastenably connect to mating fastening components **96**. In one embodiment, one surface of each of the fastening components **94** and **96** includes a plurality of engaging elements that project from that surface. The engaging elements of these fastening components **94** are adapted to repeatedly engage and disengage the engaging elements of the mating fastening components **96**.

In one particular embodiment, the fastening components **94** each include hook type fasteners and the mating fastening components **96** each include complimentary loop type fasteners. In another particular embodiment, the fastening components **94** each include loop type fasteners and the mating fastening components **96** each include complimentary hook type fasteners.

As noted previously, the illustrated absorbent article **60** has front and back side panels **88** and **90** disposed on each side of the absorbent chassis **62**. These

transversely opposed front side panels **88** and transversely opposed back side panels **90** can be permanently bonded to the composite structure comprising the absorbent chassis **62** in the respective front and back regions **64** and **66**. Additionally, the side panels **88** and **90** can be permanently bonded to one another using suitable bonding means, such as adhesive bonds or ultrasonic bonds, to provide a non-fastenable absorbent article **60**. Alternatively, the side panels **88** and **90** can be releaseably attached to one another by a fastening system **92** as described above. More particularly, as shown best in Figures 4 and 5, the front side panels **88** can be permanently bonded to and extend transversely beyond the linear side edges **98** of the composite structure in the front region **64** along attachment lines **100**, and the back side panels **90** can be permanently bonded to and extend transversely beyond the linear side edges **98** of the composite structure in the back region **66** along attachment lines **100**. The side panels **88** and **90** may be attached using attachment means known to those skilled in the art such as adhesive, thermal or ultrasonic bonding. The side panels **88** and **90** can also be formed as a portion of a component of the composite structure, such as the outer cover **72**, containment flaps, if present, or the bodyside liner **70**.

Each of the side panels **88** and **90** can include one or more individual, distinct pieces of material. In particular embodiments, for example, each side panel **88** and **90** can include first and second side panel portions that are joined at a seam, with at least one of the portions including an elastomeric material. Still alternatively, each individual side panel **88** and **90** can include a single piece of material which is folded over upon itself along an intermediate fold line (not shown). Desirably, the side panels **88** and **90** include an elastic material capable of stretching in a direction generally parallel to the transverse axis **86** of the absorbent article **60**.

To enhance containment and/or absorption of body exudates, the absorbent article **60** may include a front waist elastic member **102**, a rear waist elastic member **104**, and leg elastic members **106**, as are all known to those skilled in the art (see Figure 6). The waist elastic members **102** and **104** can be operatively joined to the outer cover **72** and/or the bodyside liner **70** along the opposite waist edges **80** and **82**, and can extend over part or all of the waist edges. The leg elastic members **106** are desirably operatively joined to the outer

cover **72** and/or bodyside liner **70** along opposite side edges of the chassis **62** and positioned in the crotch region **68** of the absorbent article **60**.

The waist elastic members **102**, **104** and the leg elastic members **106** can be formed of any suitable elastic material. As is well known to those skilled in the art, suitable elastic materials include sheets, strands or ribbons of natural rubber, synthetic rubber, or thermoplastic elastomeric polymers. The elastic materials can be stretched and attached to a substrate, attached to a gathered substrate, or attached to a substrate and then elasticized or shrunk, for example with the application of heat; such that elastic constrictive forces are imparted to the substrate. In one particular embodiment, for example, the leg elastic members **106** include a plurality of dry-spun coalesced multifilament spandex elastomeric threads sold under the trade name LYCRA and available from E.I. DuPont de Nemours and Co., Wilmington, DE.

To enhance containment and/or absorption of any body exudates discharged from the wearer, the chassis **62** may include a pair of containment flaps **108** which are configured to provide a barrier to the transverse flow of body exudates. A flap elastic member **110** (see Figure 6) may be operatively joined with each containment flap **108** in any suitable manner as is well known in the art. The elasticized containment flaps **108** define an unattached edge which assumes an upright, generally perpendicular configuration in at least the crotch region **68** of the absorbent article **60** to form a seal against the wearer's body. The containment flaps **108** can be located along the transversely opposed side edges of the chassis **62**, and can extend longitudinally along the entire length of the chassis or may only extend partially along the length of the chassis. Suitable constructions and arrangements for the containment flaps **108** are generally well known to those skilled in the art.

The absorbent articles **60** as shown in Figures 3-6 can be made from various materials. The absorbent assembly **74**, for instance, can be any structure which is generally compressible, conformable, and capable of absorbing and retaining liquids and certain body wastes. The absorbent assembly **74** can be manufactured in a wide variety of sizes and shapes, and from a wide variety of liquid absorbent materials commonly used in the art. For example, the absorbent assembly **74** can suitably include a matrix of hydrophilic fibers, such as a web of

cellulosic fluff, mixed with a high-absorbency material commonly known as superabsorbent materials. In a particular embodiment, the absorbent assembly **74** includes a matrix of cellulosic fluff, such as wood pulp fluff, and superabsorbent hydrogel-forming particles. The wood pulp fluff can be exchanged with synthetic, polymeric, meltblown fibers or with a combination of meltblown fibers and natural fibers. The superabsorbent particles can be substantially homogeneously mixed with the hydrophilic fibers or can be non-uniformly mixed. The fluff and superabsorbent particles can also be selectively placed into desired zones of the absorbent assembly to better contain and absorb body exudates. The absorbent assembly **74** can have a variable thickness, with greater thickness in "target" areas, such as in a central portion of the crotch region.

Suitable superabsorbent materials can be selected from natural, synthetic, and modified natural polymers and materials. The superabsorbent materials can be inorganic materials, such as silica gels, or organic compounds, including natural materials such as agar, pectin, guar gum, and the like, as well as synthetic materials, such as synthetic hydrogel polymers.

The absorbent assembly **74** may be formed into a web structure by employing various conventional methods and techniques. For example, the absorbent assembly may be formed with a dry-forming technique, an airlaid technique, a carding technique, a meltblown or spunbond technique, a wet-forming technique, a foam-forming technique, or the like. In one embodiment, the absorbent assembly may contain a coform material. The term "coform material" generally refers to composite materials comprising a mixture or stabilized matrix of thermoplastic fibers and one or more non-thermoplastic materials. Such other materials may include, but are not limited to, fibrous organic materials such as woody or non-woody pulp such as cotton, rayon, recycled paper, pulp fluff and superabsorbent particles or fibers, inorganic absorbent materials, treated polymeric staple fibers and the like. The coform material may be formed in a meltspun process, such as in a meltblown process.

The outer cover **72** may be made from a material that is substantially liquid and permeable, and can be elastic, stretchable or nonstretchable. The outer cover **72** can be a single layer of liquid and permeable material, or may include a multi-layered laminate structure in which at least one of the layers is liquid and

permeable. For instance, the outer cover **72** can include a liquid permeable outer layer and a liquid and permeable inner layer that are suitably joined together by a laminate adhesive.

For example, in one embodiment, the liquid permeable outer layer may be a spunbond polypropylene nonwoven web. The spunbond web may have, for instance, a basis weight of from about 15 gsm to about 25 gsm.

The inner layer, on the other hand, can be both liquid and vapor impermeable, or can be liquid impermeable and vapor permeable. The inner layer is desirably manufactured from a thin plastic film, although other flexible liquid impermeable materials may also be used. The inner layer prevents waste material from wetting articles such as bedsheets and clothing, as well as the wearer and caregiver. A suitable liquid impermeable film may be a polyethylene film having a thickness of about 0.2 mm.

A suitable breathable material that may be used as the inner layer is a microporous polymer film or a nonwoven fabric that has been coated or otherwise treated to impart a desired level of liquid impermeability. Other "non-breathable" elastic films that may be used as the inner layer include films made from block copolymers, such as styrene-ethylene-butylene-styrene or styrene-isoprene-styrene block copolymers.

Certain non-breathable elastic films may also be used to make the outer cover **72**. Examples of suitable non-breathable films can be made of styrene-ethylene-butylene-styrene or styrene-isoprene-styrene block copolymers, KRATON polymers from KRATON Polymers LLC of Belpre, Ohio, metallocene catalyzed elastomers or plastomers, and the like. Other material suitable for making the outer cover **72** include monolithic breathable films, such as those made of polyether amide based polymers, for example PEBAX, and ether/ester polyurethane thermoplastic elastomers.

Of particular advantage, the unwind system of the present invention is particularly well suited to handling outer cover materials, such as those described above, that have a low modulus of elasticity.

As described above, the absorbent assembly is positioned in between the outer cover and a liquid permeable bodyside liner **70**. The bodyside liner **70** is desirably compliant, soft feeling, and non-irritating to the wearer's skin. The

bodyside liner **70** can be manufactured from a wide variety of web materials, such as synthetic fibers, natural fibers, a combination of natural and synthetic fibers, porous foams, reticulated foams, appertured plastic films, or the like. Various woven and nonwoven fabrics can be used for the bodyside liner **70**. For example, the bodyside liner can be made from a meltblown or spunbonded web of polyolefin fibers. The bodyside liner can also be a bonded-carded web composed of natural and/or synthetic fibers.

A suitable liquid permeable bodyside liner **70** is a nonwoven bicomponent web having a basis weight of about 27 gsm. The nonwoven bicomponent can be a spunbond bicomponent web, or a bonded carded bicomponent web. Suitable bicomponent staple fibers include a polyethylene/polypropylene bicomponent fiber. In this particular embodiment, the polypropylene forms the core and the polyethylene forms the sheath of the fiber. Other fiber orientations, however, are possible.

The bodyside liner **70**, similar to the outer cover **72**, may also be made from a material that has a low modulus of elasticity. Such materials, although difficult to handle in some conventional unwind systems, are well suited for use in the system and process of the present invention.

Referring now to Figure 7, an exemplary embodiment of an assembly section **120** for making a continuous stream of partially assembled, discrete pants or garments **60** is illustrated. The specific equipment and processes used in the assembly section **120** can vary greatly depending on the specific type of garment being manufactured. The particular process and apparatus described in relation to Fig. 7 is specifically adapted to manufacture absorbent articles **60** pull-on style of the type illustrated in Figures 4 through 6.

The various components of the garment **60** can be connected together by any means known to those skilled in the art such as, for example, adhesive, thermal and/or ultrasonic bonds. Desirably, most of the components are connected using ultrasonic bonding for improved manufacturing efficiency and reduced raw material costs. Certain garment manufacturing equipment which is readily known and understood in the art, including frames and mounting structures, ultrasonic and adhesive bonding devices, transport conveyors, transfer rolls, guide rolls, tension rolls, and the like, have not been shown in Figure 7.

A continuous supply of material **122** used to form the bodyside liner **70** is provided from a supply source **124**. The supply source **124** can include for example a pair of spindles, a festoon assembly **26**, and optionally a dancer roll (not shown) for providing bodyside liner material **122** at a desired speed and tension.

As shown in Figure 7, the supply of material **122** is unwound from the supply source **124** and fed through a festoon **26** made in accordance with the present invention. In accordance with the present invention, the festoon **26** includes drive devices associated with selected guide rolls for increasing and/or decreasing acceleration rates of the guide rolls within the festoon.

In the embodiment shown in Figure 7, only one festoon and unwind device configured in accordance with the present invention is shown in unwinding material **122**. It should be understood, however, that the unwind system of the present invention may be placed at other locations throughout the process for unwinding other materials. The system of the present invention may be used, for instance, to unwind an outer cover material, and various other components used to form the absorbent article **60**.

Various components can be disposed on and/or bonded to the bodyside liner material **122** as the material travels in a machine direction identified by arrow **126**. In particular, a surge layer can be provided at an application station **128** and disposed on and/or bonded to the bodyside liner material **122**. The surge layer can include either a continuous web or discrete sheets. Additionally, a containment flap module **130** can be provided downstream of the supply source **124** for attaching pre-assembled containment flaps to the bodyside liner material **122**. As various components are added in the assembly section **120**, a continuously moving product assemblage **132** is formed. The product assemblage **132** will be cut downstream to form the partially assembled, discrete garments **60**.

A plurality of absorbent assemblies **134** can be provided from a suitable supply source **136**. The supply source **136** can be any conventional mechanism for supplying the absorbent assemblies **134**. Generally, a conventional supply source can include a hammermill for forming fluff fibers and, if desired, an enclosure for mixing superabsorbent material with the fluff fibers, and then depositing the fluff and superabsorbent material on a forming drum having a desired absorbent design. The individual absorbent assemblies **134** can be

disposed intermittently on the continuously moving bodyside liner material **122**, one for each pant. The position of the absorbent assemblies **134** can be registered with the position of the surge material, if employed. The absorbent assemblies **134** can be bonded to one or more other components using adhesives or other suitable means. Alternatively, composite absorbent materials can be fed into the converting process from rolls or compressed packages, such as festooned bales.

In Figure 7, the absorbent assemblies **134** are shown precut when fed into the process. It should be understood, however, that in other embodiments, instead of individual absorbent assemblies **134**, a continuous web of absorbent material may be fed into the process and cut into individual absorbent assemblies downstream from the supply source **136**. In this embodiment, the absorbent material may be air formed as described above, or may be formed by any other suitable process, such as a coform process, a meltblown process, a spunbond process, and the like. When feeding a continuous supply of absorbent material into the process, the material may be fed through a festoon made in accordance with the present invention. The festoon may include drive devices associated with selective guide rolls for increasing and/or decreasing acceleration rates of the guide rolls within the festoon for unwinding the absorbent material during, for instance, splicing operations.

Assembly section **120** can include a device to apply side panels. For example, continuous webs of material **138** used to form the side panels **88** and **90** can be provided from suitable supply sources **140**. The supply sources **140** can include one or more unwind mechanisms. In one embodiment, for instance, the webs of material **138** may be unwound using an unwind device and festoon configured in accordance with the present invention. The side panel material **138** can be cut into individual strips **142** and positioned partially on the bodyside liner material **122** using an applicator device **144**. In the cross machine direction, the individual strips **142** desirably extend laterally outward from the bodyside liner material **122** and overlap the bodyside liner material to permit bonding of the strips to the bodyside liner and/or the containment flap material. Bonding may be accomplished using adhesives, as is well known in the art, or by any other bonding means. In the machine direction **126**, the position of the strips **142** can be

registered relative to the absorbent assemblies **134** so that the product assemblage **132** can be cut between the absorbent assemblies with each strip **142** of side panel material **138** forming both a front side panél **88** and a back side panel **90** of consecutive garments **60**.

One suitable applicator device **144** is disclosed in U.S. Patents 5,104,116 issued April 14, 1992 and 5,224,405 issued July 6, 1993 both to Pohjola, which are incorporated herein by reference. The applicator device **144** can include a cutting assembly **146** and a rotatable transfer roll **148**. The cutting assembly **146** employs a rotatable knife roll **150** and a rotatable vacuum anvil roll **152** to cut individual strips **142** from the continuous side panel material **138**. The strips **142** cut by a blade on the knife roll **150** can be maintained on the anvil roll **152** by vacuum and transferred to the transfer roll **148**.

The rotatable transfer roll **148** can include a plurality of rotatable vacuum pucks **154**. The vacuum pucks **154** receive the strips **142** of material **138** from the cutting assembly **146** and rotate and transfer the strips to the continuously moving bodyside liner material **122**. When the strips **142** are positioned as desired relative to the bodyside liner material **122**, the strips are released from the pucks **154** by extinguishing the vacuum in the pucks. The pucks **154** can continue to rotate toward the cutting assembly **146** to receive other strips.

Alternative configurations for attaching the side panel material **138** exist. For instance, the material **138** used to form the side panels can be provided in continuous form and contour cut to form leg openings **78**. Still alternatively, the side panels **88** and **90** of the pant **60** can be provided by portions of the bodyside liner **70** and/or outer cover **72**. It should be noted that the side panel application processes just described are exemplary only, and that the process can vary greatly depending on the physical characteristics of the material and the nature of the process.

A continuous supply of material **156** used to form the outer cover **72** can be provided from a supply roll **158** or other suitable source. In one embodiment, the outer cover material **156** may be unwound from the supply roll **158** using the unwind system made in accordance with the present invention. As the material is unwound, the outer cover material **156** can be married with the bodyside liner material **122** such as by use of a laminator roll **160**. The absorbent assemblies

134 are thereby sandwiched between the continuous materials **122** and **156**. The inward portions of the strips **142** of side panel material **138** can also be disposed between the bodyside liner material **122** and the outer cover material **156**. Various components such as leg elastics **106** or waist elastics **102** and **104** can be bonded to the outer cover material **156** at an application station **162** prior to uniting the bodyside liner and outer cover materials **122** and **156**. Alternatively, leg elastics or waist elastics can be initially bonded to the bodyside liner material **122** or another material.

The outer cover **156** can be joined to the liner-side panel composite using any means known to those of skill in the art. Where an adhesive is used, the adhesive can be applied on or prior to laminator roll **160**. Alternatively, bonding devices such as ultrasonic or thermal bonders can be employed as part of the laminator roll **160** or at a downstream location **164** to bond the bodyside liner material **122**, side panel material **138** and outer cover material **156**.

The assembly section **120** can include apparatus to provide/apply a fastening system to the garment **60**. For example, the continuously moving product assemblage next advances to a fastener application station **166** where fastening components **94** and **96** are bonded to the strips **142** of side panel material **138**. The location of the fastening components on the composite is a function in part of the configuration of the assembly section **120**. The illustrated assembly section **120** is configured so that the upwardly facing surface of the product assemblage **132** will become the outer surface of the pant **60** and the downwardly facing surface will become the inner surface. Moreover, the illustrated assembly section **120** is configured to produce partially assembled garments **60** having the front waist region **64** of a leading garment connected to the back waist region **66** of a trailing garment. The process could alternatively employ any combination of different orientations. For example, the upwardly facing surface of the product assemblage could form the inner surface of finished garments. Additionally or alternatively, the back waist region **66** of a leading garment can be connected to the front waist region **64** of the trailing garment, or the garments can be arranged in a front-to-front/back-to-back relationship. Still alternatively, the assembly section **120** can be constructed as a cross-machine direction process

wherein the longitudinal axis of each garment could be perpendicular to the machine direction **126** during part or all of the assembly process.

As shown in Figure 1, continuous webs of a fastener material **178** used to form the fastening components 96 (Figs. 4 and 6) can be provided from supply rolls **180** or other suitable sources. The fastener materials **178** can be cut into individual fasteners **96** by cutting assemblies **182** or other suitable devices. The illustrated cutting assemblies **182** include rotatable knife rolls **184**, rotatable vacuum anvil rolls **186**, and rotatable backing rolls **188**. The continuous fastener materials **178** can be cut by blades on the knife rolls **184**, maintained on the anvil rolls **186** by vacuum, and disposed on the top surfaces of the strips **142** of side panel material **138**.

Similarly, continuous webs of a fastener material **190** used to form the fastening components **94**, shown in Figs. 4 and 6, can be provided from supply rolls **192** or other suitable sources. The first fastener materials **190** can be cut into individual first fasteners **94** by cutting assemblies **194** or other suitable devices.

In the embodiment shown in Figure 7, the supply rolls **180** and **192** are shown feeding the material **178** and the material **190** into the process. In accordance with the present invention, if desired, supply rolls **180** and **192** may be supplied from an unwind device that is in communication with a festoon made in accordance with the present invention.

Alternatively, a component of the garment **60** may serve as the fastening components, in which case the fastener application station **166** or the cutting assemblies **194** may not be needed. The illustrated cutting assemblies **194** include rotatable knife rolls **196**, rotatable vacuum anvil rolls **198**, and rotatable backing rolls **200**. The continuous fastener materials **190** can be cut by blades on the knife rolls **196**, maintained on the anvil rolls **198** by vacuum, and disposed on the undersides of the strips **142** of side panel material **138**.

Other arrangements can be used to attach the fastening components **94** and **96**. For example, the fastening components can be applied to the side panel material **138** prior to uniting the side panel material with the bodyside liner material **122** and/or the outer cover material **156**; the fastening components can be applied to the bodyside liner material **122** and/or outer cover material **156**, whether separate side panels are used or not; portions of other components such as the

bodyside liner and/or outer cover can form one or more of the fastening components; the separate side panels or integral side panels can themselves form one or more of the fastening components; the fastening components can be attached as pre-engaged composites; or the like.

After the fastening components are disposed on the strips **142** of side panel material **138**, bonding devices **202** such as ultrasonic bonders can be employed to bond the fastening components to the strips. For example, the strips **142** can be transported between a rotary ultrasonic horn and an anvil roll, which devices are positioned on each side of the process at the cross machine direction location of the fastening components **94** and **96**. Particular ultrasonic bond patterns including individual, circular bonds which are compatible with mechanical fastening materials are disclosed in U.S. Patent 5,660,666 issued August 26, 1997 to Dilnik et al., which is incorporated herein by reference. Efficient arrangements for attaching the fastening components with nonadhesive bonding devices are further described in U.S. Patent No. 6,562,167, filed on May 15, 2001 by J. D. Coenen et al. and titled "Methods For Making Garments With Fastening Components", which is incorporated herein by reference. For secure attachment, it may be desirable to attach the fastening components with both adhesive and thermal bonds. Suitable attachment adhesives are available from commercial vendors such as Findley Adhesive, Inc., Wauwatosa, Wisconsin U.S.A.

The strips **142** of side panel material **138** can be trimmed if desired, for example to provide angled and/or curved leg end edges in the back waist region. To this end, the assembly section **120** can include a die cutting roll **204** and a backing roll **206**. In the illustrated embodiment, a portion of each strip **142** is trimmed from a trailing edge in order to form the angled and/or curved leg end edges in the back waist region.

The method and apparatus to this point provides a continuous web of interconnected and partially assembled pants moving in the direction indicated by arrow **126**. This continuously moving product assemblage **132** is passed through a cutter **208** which selectively cuts the web into discrete, partially assembled garments **60**. Such cutters **208** are generally known to those skilled in the art and can include, for example, the combination of a cutting roll **210** and an anvil roll **212** through which the web travels. The anvil roll **212** can include a hardened steel

rotating roll while the cutting roll **210** can include one or more flexible hardened steel blades clamped onto another rotating roll. The pinching force between the blade on the cutting roll **210** and the anvil roll **212** creates the cut. The cutting roll **210** can have one or more blades depending upon the desired distance between the cuts. The cutter **208** can further be configured to provide a spacing between the individual cut pieces after they are cut. Such a spacing can be provided by transferring the cut pieces away from the cutter at a higher speed than the speed at which the web is provided to the cutter.

The discrete garments **60** can then be folded and packaged as desired.

These and other modifications and variations to the present invention may be practiced by those of ordinary skill in the art, without departing from the spirit and scope of the present invention, which is more particularly set forth in the appended claims. In addition, it should be understood that aspects of the various embodiments may be interchanged both in whole or in part. Furthermore, those of ordinary skill in the art will appreciate that the foregoing description is by way of example only, and is not intended to limit the invention so further described in such appended claims.